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Peer to Peer Adult Learning Engagement in Online Collaborative Learning: Characteristics and Learning Outcomes

Completed Research Paper

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Abstract

The purpose of this study is to investigate an under-researched area of adult learning in informal and unstructured online spaces. The first phase of the project involved a systematic review of 31 studies on adult learners' peer-to-peer (P2P) interactions in online learning environments. The aspects explored were: (1), the characteristics of adult P2P engagement in online collaborative learning environments; (2), the impacts of that engagement on the learning outcomes of adult learners; and (3), the factors that could facilitate or hinder adult engagement in such environments. The review revealed that most studies investigated the broad effects of P2P adult learning on learning outcomes. These effects suggest that: (1) the adult learning efficiency could be improved through the application of more specialized approaches; and (2), that various unexplored factors may be important in facilitating P2P adult learning. This research will allow for better consideration of adult learning processes and activities.

Keywords: Peer-to-peer engagement, learning outcomes, online collaborative learning, systematic review

Introduction

Understanding how adult learners engage with their peers in online collaborative learning environments is increasingly important, as more adults choose online platforms to engage in learning and personal development (Abedin et al., 2010; Malinen, 2015; Pavalache-Ilie et al. 2014; Salaber 2014). One such platform is GitHub, one of the world's largest online collaborative communities for software developers. Through GitHub, over 20 million adult members help each other out in learning new software development skills. Despite the growing popularity of environments such as GitHub amongst adult learners and professionals, it is not yet clear how adult learners engage with their peers to achieve learning outcomes (Abedin et al., 2012; Brookfield, 1995). Understanding this engagement is particularly important, as the adult learning practice is self-directed and it spans a learner's life time (Salleh, 2015), unlike the pursuit of a particular degree which is instructor-driven and lasts a relatively short period (Ference et al., 1998). Also, adults deal with a lot of life challenges including lack of time because of work and family commitments, multiple career roles and living longer (Cercone, 2008); thus, the transition from a traditional learning environment to an online collaborative learning environment adds further difficulties to the adult learning practice (Eastmond, 1998). Therefore, the focus of this research is to: (1), conceptualize adult learners' characteristics in online collaborative learning environments; (2), investigate how adult learners engage with their peers; and, (3) illuminate how this engagement affects the learning outcomes.

Learner engagement in online learning environments can be categorized in various ways. For example, Salaber (2014) divided it into engagement with the coordinator/instructor, engagement with faculty or the learning organization, and engagement with their peers. Pellas et al. (2013) categorized engagement as interactions with others (peers), and interactions with the learning environment and university. The focus of this paper is on adult learners' engagement with their peers, and how this may relate to their learning outcomes. While a growing body of

research focuses on engagement in online collaborative learning environments (Han et al. 2014), few studies have targeted adult P2P learning engagement and its effects on learning practices. Previous researchers have investigated aspects of engagement including its effects on learners' capabilities (Artino, 2012), deeper aspects of their interaction with online collaborative learning environments (Limbu et al. 2014), level of engagement in the online environment (Esteban-Millat et al., 2013; Nam, 2014; Abedin, 2011), the specific type of engagement needed to achieve academic goals (Hung et al., 2014), and their P2P engagement skills (Kuong, 2014). The literature on online learning to date has stressed the value of all learners' engagement in achieving better learning outcomes (Kuong, 2015), and focused on how the capabilities of online collaborative environments facilitate peer-to-peer (P2P) engagement (Hew, 2014). While most previous studies in the literature concur that P2P engagement in online learning environments has a positive effect on learners' learning outcomes, less attention has been paid to characteristics of P2P adult learning in online collaborative environments (Stott, 2014). Furthermore, recent studies have called for more research into the impact of adult P2P engagement on learning outcomes and the factors that may impact it (Deschacht et al., 2015; Chu et al., 2012; Ruey, 2010).

This paper aims to address these gaps through conducting a systematic literature review and synthesizing the existing research in this area. The broad aim of this research is to investigate P2P adult learning characteristics in online collaborative learning environments, its impacts on adult learning outcomes, and how the engagement occurs through the factors that may facilitate or hinder adult learning engagement in online learning environments. Given the above aims, two main research questions guide this research:

- RQ1. What are the characteristics of adult learning in online collaborative learning environments?
- RQ2. Which factors may facilitate or hinder P2P adult learners' engagement, and how they impact learning outcomes?

The paper presents an overview of the state-of-the-art research on P2P adult learning in online collaborative learning environments; this overview includes identification of gaps in the current research. Next, the paper identifies three aims of relevance for research as well as practice: (1), to describe adult learning characteristics; (2), to gain insights into what P2P engagement in adult learning is about; and, (3) to clarify effective learning outcomes. These aims are then addressed using a systematic literature search and a narrative review method to synthesise the selected literature; an elaboration based on the analyses of the collected studies follows. The paper concludes with a discussion of main findings and suggestions for future research.

Research Background

Adult learning is part of a continuous learning concept that takes place over a lifetime (Cerccone, 2008; Salleh et al., 2014) and is not bound by age limitation of the learner (Cerccone, 2008). It includes a set of interconnected activities to enhance life through improving skills, knowledge, and capabilities. This continuous process considers learning as a "process whereby knowledge is created through the transformation of experience" (Kolb, 1984). Experimental learning along with characteristics of adult learning are very important tools for teaching adult learners (Salleh et al., 2014). According to Egizii et al. (2015), adult learners seek a learning style that meets both their individual learning need and the need of participating in the real world life. This way of learning contributes to allowing learners a new place in the society and gaining a competitive advantage in the workplace after graduation. Merriam and Caffarella (1991) described adult learning as a self-directed learning practice that is triggered by real life experiences, which means adult's everyday actions are components of the adult learning process. Erdei et al. (2014) explained that studying adult learning is important, because of expansion of learning in all levels of education and participation, potential to influence learners in society, advantage of renewed education based on objectives, and more flexibilities to deliver. While adult learning is a branch of learning practices in general (Abedin et al., 2014), and while there is a lot of research on adult learning in traditional and offline classes (Cerccone, 2008), less has been done in characterizing adult learning in online collaborative learning environments. This study aims to use existing theories for characterizing adult learning and extend it to apply to online collaborative learning environments. Although the above definitions of adult learning place the importance on the adult learners' behaviour, learning theories help in describing adult learning characteristics and provide the overall framework for teaching and learning activities (Merriam & Caffarella, 1999; Pence, 2016).

From the various adult learning theories, this study adopts Andragogy adult learning theory for characterizing adult learning in online collaborative learning environments. Andragogy (Knowles, 1973) models adult learning practices in real life. This theory, also known as Management of Technology (MoT) pedagogy or Lifelong Learning (LLL) theory (Muresana, 2014; Sung; 2014), was later extended by Dan Berg et al. (2015) to describe adult learning practices in online learning environments. Andragogy was considered for this current study, because it is a learning theory that is designed to address the specific adult needs. It was developed based on significant differences in learning characteristics between young and adult learners (Knowles, 1980), and adopted by various scholars for online learning environments (Cerccone, 2008, Dan Berg et al., 2015). Andragogical theory explains adult learning characteristics in terms of the following four main assumptions (Knowles, 1980):

(i) Independent self-concept: Andragogy refers to adult learners' independent practice and ability to direct their own learning practice (Knowles, 1989). In other words, adults with schooling practice experience have been constructed as "dependent" learners, and instructors direct them from old habits to start thinking responsibly of their learning (Cercione, 2008; Pence, 2016).

(ii) Experienced-Centred: The second assumption underlying andragogy is the importance of using learners' experience in relation to new information (Knowles, 1989), which means "an adult accumulates a growing reservoir of experience, which is a rich resource for learning" (Merriam & Caffarella, 1999). As emphasised by Cercione (2008), "adult students can build on previous knowledge and experience by relating new information to past events and experience".

(iii) Professional outcome: The third assumption shows that the readiness of practice learning is related to the output of developmental tasks for acting social roles (Knowles, 1989) and "the readiness of an adult to learn is closely related to the developmental tasks of his or her social role" (Merriam & Caffarella, 1999).

(iv) Problem-Centered: The fourth assumption emphasizes the orientation to learning practice. Adult learners are most problem-centered in comparison with subject-centered young and child learners (Knowles, 1989). It is important that the learning activities align with a relevant life problem. The adult learners believe that they are being prepared for real tasks and responsibilities after completing learning practice in more complex environments (Cercione, 2008).

Gaps in the literature

Several theories attempted to explain adult learning previously (Smith, 2002; Cercione, 2008) by highlighting adults learning characteristics for today's life (Cercione, 2008). While existing studies have identified and described adult learning characteristics in traditional or collaborative learning environments, they have not examined the effects of P2P adult learning engagement in online collaborative learning environments. Previous studies mostly developed adult learning characteristics independent from the learning environment, while some researchers assessed adult learning characteristics only based on the age of learners. Thus, this study addresses two major gaps in the current literature:

(1) Characteristics of P2P adult learning engagement in online collaborative learning environments:

Peer to peer adult learning in online collaborative learning environments have not been characterised in the past literature (Cercione, 2008). Additionally, how the adult learning occurs in the online learning environment has not been well explored due to the nature adult learners' busy life and learning style (Huang, 2012; Cercione, 2008). Therefore, defining the characteristics of adult learners is important to provide an efficient engagement framework to improve learning outcomes. This review attempts to provide categorisation clarity by defining different forms of adult learners' characteristics and possible ways of being categorized and conceptualised using relevant theories. It also attempts to synthesize recent studies that focus directly on P2P adult learning engagement using andragogy theory to respond to the current lack of application of relevant theories to adult learning practices in online collaborative learning environments (Ruey, 2010).

(2) P2P adult engagement in online collaborative learning environments and the learning outcomes:

Although currently various theories and models have been proposed in the literature for describing adults' engagements in online learning environments, less attention has been paid to describing learning outcomes of adult P2P engagements. For example, the learning style in online learning environment is still new to some adult learners, and adult learners may have trouble adjusting to the online collaborative learning environment (Hashim et al., 2014), including the capacity of using social media for interaction (Wang et al., 2015). More research is needed to investigate how adult learners engage with their peers, and whether they find such engagements encouraging, and if a P2P online experience is less or more satisfying for them than traditional learning practices. Conrad (2008) found that learners seldom demonstrate the benefits they acquire from participating in online learning activities in their workplace. Whether and how a constructivist online course may help adult learners learn more authentically and meaningfully from a holistic perspective needs to be further examined. This study explores in what ways adult learners benefit from a constructivist-based online learning environment.

Research Method

Systematic literature review has been chosen for this study in order to identify and review how adult learning characteristics have been defined, elaborated, and presented in academic research articles. A systematic review has been conducted using a systematic, rigorous, and standard procedure, aiming to summarize existing research on the topic and to include an element of analytical criticism. In a stand-alone literature review, literature in a chosen field is reviewed without collecting or analyzing any primary data; at most, results from the reviewed studies might

be analyzed as data for the literature review (Vangrieken et al., 2015). This research followed Kitchenman's (2007) and Cao et al. (2014) guidelines in the literature review of P2P adult engagement in online collaborative learning environments. The objective was to use search terms that would capture the essence of adult learning engagement in online collaborative environments. Other selection criterion for the review was ensuring that the studies focused on P2P adult engagement. To exhaustively explore the key focus, each selected study was reviewed in depth to assess how it addressed the research objective. The review was limited to the top 10 journals recommended by Australian Council of Professors and Heads of Information Systems (<http://www.acphis.org.au/>) as well as the top 10 journals for Online Education research recommended by Scimago Journal & Country Rank (<http://www.scimagojr.com/>) (Cao et al., 2014). The selected publications were reviewed and organized into categories by searching the following keywords:

“adult learning” OR “adult learners” AND “online learning environments” OR “computer supported collaborative learning” AND “engagement” OR “peer to peer interaction”

The review had three specific research aims: to (1) explore characteristics of adult learners, (2) gain insight into the impact of P2P adult learning on learning outcomes, and (3) identify the factors influencing P2P adult learners' engagement. These aims were addressed using a literature search and a deep review method to synthesize the selected literature.

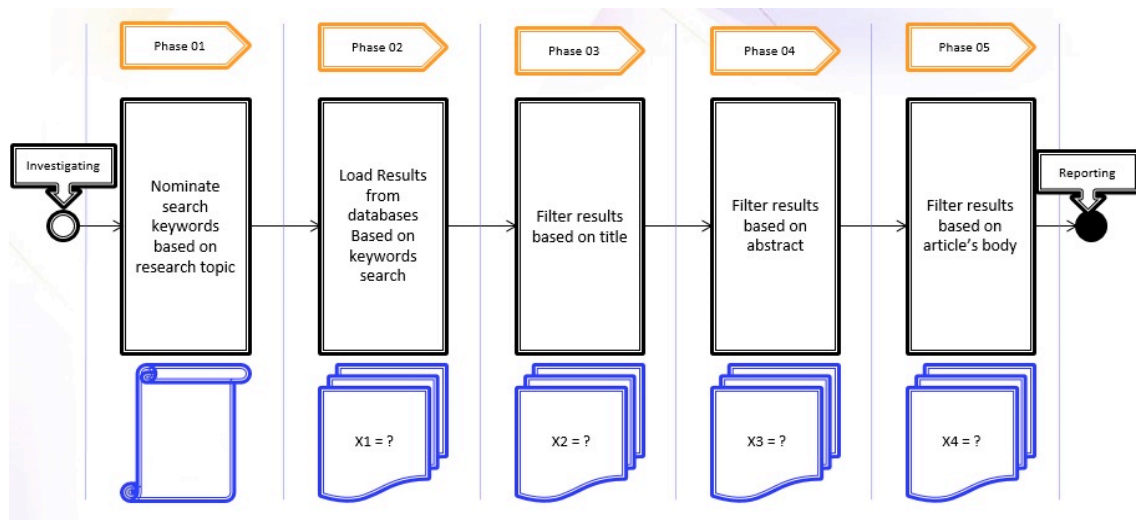


Figure. 1 : The publication selection process

Figure.1 shows the search process for selecting papers for our review. The search was conducted in September 2016 to retrieve initial papers. As Table 1 shows, the second phase was to conduct the search using the search terms. Next, results were filtered on the basis of publication titles. Publications with titles that did not contain the search terms were excluded. The remaining papers were further assessed by their abstracts. After that, if necessary (if the abstract did not provide sufficient information), the full text was assessed. Then, a snowballing technique was used, in which the references of sources that were deemed relevant were examined to find other important studies. These were again judged based on their title, abstract and, if necessary, further reading. The relevance of the delivered sources was judged using selection criteria specified in advance that are discussed in the next subsection. To ensure the relevance of the selected literature, the following criteria were applied during the selection process:

- The discussed engagement in selected papers had to pertain to P2P adults' engagement and interaction and adults' collaboration had to be the primary focus;
- Sources had to have a primary focus on online collaboration (P2P engagement or interaction); and,
- Literature discussing P2P adults' engagement (direct/indirect) in online collaborative learning environments in languages other than English was excluded.

Table 1: Studies initially identified and ultimately included, by journals.

Journal Type	Journal	Phase 2: Keyword Search	Phase 5: Final selections
Information Systems	European Journal of Information Systems	19	1
Information Systems	Journal of Information Technology	11	3

Information Systems	Journal of the Association for Information Science and Technology	42	1
Education	Journal of Engineering Education	15	1
Education	Journal of Research in Science Teaching	16	1
Education	American Journal of Education	69	3
Education	Review of Educational Research	64	0
Education	Computers and Education	21	5
Education	The Internet and Higher Education	3	2
Education	Procedia - Social and Behavioral Sciences	50	9
Education	Computer in Human behaviour	3	1
Education	British Journal of Educational Technology	19	5
Total		366	31

Results

The initial database search strategy resulted in 366 papers, out of which 65 full text articles were assessed for eligibility and ultimately 31 papers were considered relevant for this review.

Demographic results

From 31 selected papers, 27 were from educational journals, which primarily contributed to defining adult learning characteristics. There were 4 studies in information journals, which mainly discussed P2P adult learning in online collaborative learning environments. Figure 2 shows the frequency of selected studies based on their regions and countries. The highest number of papers was published in Europe (13). South Asian country published 8 and North America 6. The highest number of papers per country was selected from USA (6) and Taiwan (5); Australia and Malaysia shared the third place with 3 papers each. At the end of this list, with 1 paper each, were Nigeria from Africa, Iran from Middle East, Ireland, Germany, Hungary, Netherland, Cyprus and Greece from Europe.

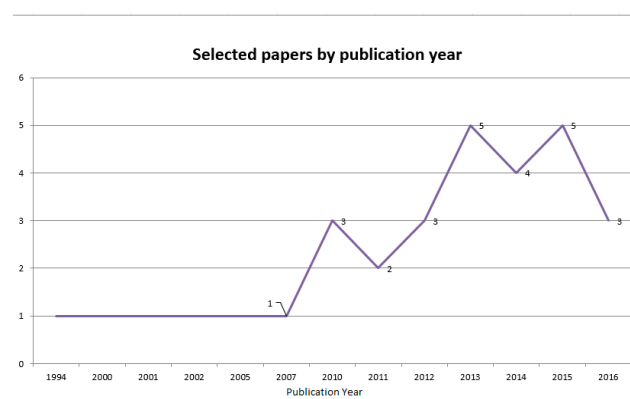
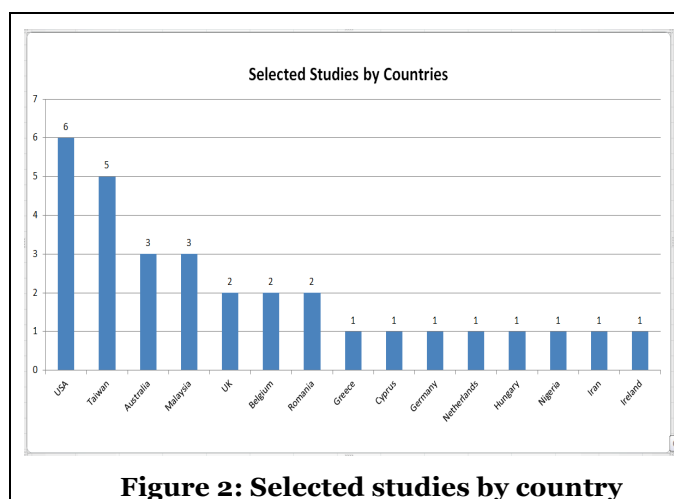


Figure.3 shows the number of selected studies by their publication year, which shows most studies have been published in 2010 or later. This figure also shows a growing number of publications in this field over time, which suggests more scholars have been recently studying adult learning practices in online environments.

Presence of reviewed theories

While some of the reviewed papers did not use any theories at all, the following theories were the most commonly used theories in the review of selected papers:

Andragogy (Knowles, 1980): This theory was designed and proposed to address the special needs of adult learners (Cercone, 2008; Huang, 2002; Ismail et al., 2010; Salavastru, 2014). This theory includes set of basic principles for adult learning and basic initial differences between adult learning and other learning practices. It was adopted to apply at work in industry, universities, and governments to invent new innovative learning practices or justification for the old ones. Smith (2002) pointed out that Knowles' (1989) concept of andragogy is a beginning

attempt to build a theory of adult learning, and that it "is anchored in the characteristics of adult learners"(Cercone, 2008). This theory is particularly useful for this study, as it helps to identify adult learning environments based on their characteristics and elaborating P2P adult learning engagement in these environments.

Wedemeyer's learner-centered theory (a general theory of the pedagogy): This theory proposed industrializing learning and teaching and emphasised the interaction between learners and environments including the other learners and instructors.

Transformative learning theory proposed by Mzeirow (1991, 2000): This theory described the process of adult learning and re-evaluation of past experience and adult learning. It mentioned that adult learning is an individual process that can differ from one environment to another; therefore, online collaborative learning environment is a paradigm shift for adult learning (Chu et al., 2012)

Uses and Gratification theory (UGT): this theory is widely used to examine self-motivation of adult learning in online collaborative learning environment (Hashim et al., 2015).

Characteristics of adult learning in online collaborative learning environments

On the basis of andragogy, Knowles (1970) listed four assumptions for adult learning practice (Cercone, 2008): (1) self-concept; (2) using experience; (3) readiness to learn; and (4) orientation toward learning shifts from subject-centeredness to problem-centeredness. In addition to the above four categories, the systematic literature review revealed a fifth category 'informal lifelong learning'. Then, andragogy was used to make consistence title/application for each theme based on their similarities. Table 2 summarizes categories for adult learning themes.

Table 2: Categorizing adult learning characteristics using andragogy theory

Theme/category	Brief Description	Characteristics	Studies
Independent self-directed	Self-directed emphasis on learner-centres based activities (Chu et. al, 2012)	Independent learner self-competence	(Ruey , 2010)
		Individual learner	(HUTCHISON et al. 1994)
		learner-centred	(Dupin-Bryant, 2004)
		Self-Concept	(Oghenekohwo, 2013)
		Naturally independent	(Salleh et al., 2015)
		Self-directed	(Chu et al.,2012)
		Self-directed	(Hashim et al., 2015)
		Self-directed	(Cheng et al., 2011)
Experienced-Centred	Salavastru (2014) defined adult learning as experiential learning which implies an interaction between person and past experience	Previously explored knowledge	(Maya Saba et al. 2013)
		Knowledge reflection	(Sealea et al., 2000)
		Experience-based	(Oghenekohwo, 2013)
		Experiential learning	(Salavastru , 2014)
		Life/employment experience learning	(Chu et al.,2012)
		Experiential learning	(Haung, 2002)
Professional outcome	Adult learners require knowing the relation between learning practice and work-related outcome (Neville et al. 2015)	Career experience	(Lounsbury et al. , 2007)
		Skill-oriented learning	(Neville et al., 2015)
		Work immediate usefulness	(Kang et al., 2016)
		Carried out learning	(Cheng et al., 2011)
		Readiness	(Oghenekohwo, 2013)
		Obtain information work-related	(Slev et al., 2012)
		Ready to leean	(Dimitrescu et al., 2015)
		Professional-problem oriented	(Salavastru , 2014)
		Work-related learning	(Tonseth, 2014)
		highly-motivated	(Shapira et al., 2001)
Problem-Centred	Adult learners thinking as learning as problem-based practice. (Salleh et al., 2015)	Problem-based learning	(Krishnan et al., 2011)
		Problem-based	(Ioannou , 2015)
		Problem-orientation	(Oghenekohwo, 2013)
		Problem-based	(Salleh et al., 2015)
		Problem-based	(Dimitrescu et al., 2015)
		Real life problem solving	(Haung, 2002)

Informal lifelong learning	Lifelong learning is mainly definition of adult learning by grouping multiple activities leading to learning for adult learners (Christidou et al., 2012).	Informal experience	(Falk et al. 2013)
		Lifelong learner/learning	(Deschacht et al., 2015)
		Life-long venture	(Leen et al., 2013)
		Lifetime process	(Sallah et. al, 2015)
		Lifelong learning	(Lin et al. 2013)
			(Postan, 2014)
			(Erdei, 2014)
			(Slev et al., 2012)
			(Christidou et al., 2012)
			(Haung, 2002)
			(Ismaila et al., 2010)
			(Baptista , 2011)
			(Tonseth, 2014)

The independent self-concept term refers to adult learners' independent self-centred activities and the ability to drive their own learning in online collaborative learning environments (Chu et al., 2012). According to Hashim et al. (2015), adult learning is a self-directed and highly motivated practice to achieve learner-centred goals. It is recognized that most adults are independent in choosing and selecting the activities in their learning practice including effective learning approach (Hashim, 2002) and learning practice's style in online collaborative learning environments (Dupin-Bryant, 2004). Effective adult learning is also highly related to the integration of past experience and the ability to discuss and collaborate with peers (Hashim, et al., 2015) because adult learners use past experience as a main learning resource (Chu et al., 2012).

The experienced-centred characteristic underlines that adult learners use their own experiences as a main learning resource to gain new knowledge in online collaborative learning environments (Chu et. al, 2012). According to Sealea et al., (2000), adult learners obtain new information in relation to their previous experiences or past events. In this definition, adult learning mainly occurs in reflection on action which means adult learners take action on past experience to discover new knowledge (Sealea et al., 2000). Salvastru (2014) argued that knowledge originally comes from experience and will be validated again within new life experiences of adult learning, i.e. adult learning is a life-long continuous practice and learning improves (either through gaining of new knowledge or validation of old one) by new experiences during life time.

The professional outcome is another important characteristic in the adult learning practice. Adult learners are motivated by learning objectives which meet their needs (Cheng et al. 2011). They pursue learning practices that may improve their personal development for enhancing either their job satisfaction or career professionalism (Lounsbury et al., 2007; Kang et al., 2016). Neville (2015) argued that adult learning should only tackle problems that relate to the career improvement and transfer knowledge to the learner. Dimitrescu et al., (2014) emphasized the aspect of adult learning that sought to find a better pathway to upgrade career or change lifecycle. This includes engaging with the others using online collaborative learning environments for sharing knowledge and gaining insights into new learning materials. In addition to that, the objective of professional learning is to activate human potential to empower individuals working in a community (Baptista, 2011). Tonseth (2014) reported that learning cannot be limited to a certain phase of life and adult learning is spread through life, including professional career and living in a community.

Next characteristic is problem-centered, which focuses on adult learners' skills for gaining new knowledge for solving real problems. Adult learners need to know how learning practice can resolve a real problem and why they should learn something. The goal in adult learning has been identified as a new way or knowledge to solve a problem so they should know how they might use it in the future (Cercone, 2008; Ioannou, 2015). Sealea et al. (2000) explained that adult learners create meaning by re-framing an old experience to engage in solving today's problem in the workplace or life. Adult learners re-frame problem as well as experience to gain constructive meaning. Salleh et al. (2015) elaborated the learning process by using experience to solve a present problem and mentioned that learning orientation in adult learning is shifted from subject-based (formal) to problem-based (informal). Additionally, Salavsatru (2014), described the adult learning practice flow (mentioned above by Salleh et al.) as a conceptualization process: adult learners are willing to acquire new knowledge by learning new skills because it helps them to solve real professional problems in life or workplace.

And finally, lifelong learning is another characteristic of adult learning (Postana, 2014). Behind the word lifelong learning there is a range of complex activities and processes. There are several different aspects around the term of lifelong learning and some of them are becoming more common, including learning communities, life-long learning and lifelong organizations (Erdeia et al., 2014); these terms apply to different aspects of our lives or duties and vary between community and learners activities (Erdeia et al., 2014). The concept of lifelong learning includes self-learning (Slev et al., 2012) and lifelong process (Salleh et al., 2015). Dimitrescu et al., (2014) added to that the desire to find a better job or career and argued that as the lifecycle of professionalism lasts a lifetime, lifelong

learning is a new theme for adult learning; this includes using online collaborative learning environments, educational institutions, and universities. In addition, lifelong learning is a process of activating human potential to empower individuals working in a community by a continuously supportive process to gain knowledge, values and skills (Baptista, 2011). Tonseth (2014) reported that learning cannot be limited to a certain phase of life and adult learning is spread through lifetime, starting in early childhood and finishing at the end of life.

Factors influencing adult learning outcomes in online collaborative environments

Most of the reviewed papers reported an improvement in learning outcome by measuring the effects of factors which facilitate engagement or interaction between peers in their studies. For example, Chen et al., (2015) mentioned networking increases the level of interaction between peers and therefore an improvement in learning outcome. Saba et al., (2013) have discussed past knowledge as another influential factor, which increases learners' awareness and eventually improves their learning outcome. Lin et al., (2013), discovered two factors which facilitate peer to peer engagement in learning practice and claimed that both enhance learning outcomes. Firstly, well-designed interactive online environment which facilitates P2P interaction and secondly, more time spent in an online collaborative learning environment which increases the level of interaction between peers. Sealea et al., (2000) described reflection on action as a factor which increases the ability to extract new knowledge from past experience; reflection on action was said to lead to better learning outcome by improving problem solving skills through using shared experiences between peers. Lucardiea (2014) identified fun and enjoyment as a key factor in adult learning improvement; if the learning process is attractive to peers, they engage in interaction with each other and improve their learning outcome.

On the other hand, Huang (2002) underlined the incomplete, ineffective or even erroneous information factor as a hindrance to peer to peer engagement and efficient adult learning and suggested mentoring as a way to resolve the problem Huang (2002); this might not apply to all online collaborative learning environments though. The fact that Huang (2002) was the only study in the review that studied factors that would hinder adult learning outcomes shows a lack of research in this area, and calls for more investigation into what may discourage adult learners' interactions and hinder their learning outcome in online collaborative learning environments. Table 3 presents a summary of factors that facilitate or hinder learning outcomes of adults in P2P online collaborative learning environments.

Table 3: Categorizing factors which facilitate or hinder P2P engagement in adult learning

Study	Impact on learning outcome	Factors		Brief Description
		Facilitate	Hinder	
(Chen et al. 2015)	Improve interaction in social networking	Networking		networking facilitates members in their one-to-one networking activities
(Saba et al. 2013)	further comprehension and awareness	Prior knowledge		students' prior knowledge, build on their current understanding
(Lin et al. 2013)	broad and deep interactions	well-designed collaborative environments		facilitates both broad and deep interactions
(Lin et al. 2013)	deeper and extended discussions and to reach consensus	more time for online interaction		more time for online discussions to facilitate deeper and extended discussions
(Sealea et al., 2000)	adult learners act on experience	reflection on action		reflection on action sharing experience to obtain knowledge
(Ke, 2013)	moderate the quality adult learning	self-regulated		The quality of learning will be higher in adult learning
(Lucardiea, 2014)	Increase interaction	fun and enjoyment		adult learners interaction identify the fun & enjoyment
(Huang, 2002)	Distracting process		erroneous information	As a matter of fact, some learning takes place beyond the scope
(Chu et al., 2012)	Improve online Adult learners' communication	Interacting learning		Interaction learning facilitates adult learners' learning practice.

Discussion and direction for future studies

This study undertook a systematic review of the literature on P2P engagement of adult learners in online collaborative learning environments. The first aim of this review was to provide an overview of how adult learning was characterized in previous research. During exploring the literature, it became clear that different terms were used to refer to adult learning characteristics; they were often interchanged and interconnected. However, it was not clear whether the terms referred to the same characteristic of adult learning, making it difficult to draw conclusions from current literature. In order to cope with this deficiency, this review relied on andragogy to clarify the definition of adult learning and distinguish between the different terms used in the literature. In the next step, this review attempted to present a clarified terminological framework by categorizing characteristics from literature in selected studies and explore them in online collaborative learning environments (Table 4).

Table 4 : Categorizing of characteristics using Andragogy theory				
Characteristics	# of Studies	Type	Andragogy	Short Description
Independent self-directed	8	Learning Style	Yes	Adult learners are individual
Experienced-Centered	6	Learning Motivation	Yes	Adult learners use experience to extract new knowledge
Professional outcome	10	Learning Motivation	Yes	Adult learners require knowing the relation between learning practice and work-related outcome (Neville et al. 2015)
Problem-Centered	6	Learning Style	Yes	Adult learners thinking as learning as problem-based practice. (Salleh et al., 2015)
lifelong learning	13	Learning Style	No	Lifelong Learning is the process of activating human potential to empower individuals working in community (Baptista, 2011)

This study is not without limitations. Limiting the search to the top 10 highly cited information systems as well as education journals may have resulted in the exclusion of potentially eligible studies related to the topic. However, some critical journals and papers were added manually to make sure that the findings included the most relevant studies for the literature review. Categorizing adult learning's characteristics from literature allows researchers to identify the areas of adult learning process and activities, as well as the gaps and opportunities for further research. Based on the results, four directions for future adult learning research are proposed to address the research question of "How might P2P adult learning engagement impact adult learning in online collaborative learning outcome?"

The second aim of this study was related to factors which may facilitate or hinder P2P adult learning in online collaborative learning environments. Findings of the review showed that these factors can be diverse and can be applied in different situations. While this review has provided some evidence against the research questions, it revealed a lack of empirical evidence in the literature in relation to P2P engagement in adult learning environments. It also revealed a lack of clear definitions for adult learning practices in online environments, and what is sometimes seen as the age-related learning versus experience related learning. Much literature in this area tends to focus on traditional learning environments, which has led to a strong belief about the effectiveness but significant evidence gaps related to how adult learning actually happens and recommendation of how P2P engagement in online adult learning environments can be improved (Abedin et al., 2012). For example, adult learning depends upon past experiences (Ruey, 2010) and learners extract new knowledge by rearranging solved problems (Huitink et al., 2015). These experiences can be shared between peers in a direct or indirect way, by providing advice using online collaborative learning environments but in some cases shared information is incomplete or ineffective for learning outcome (Huang, 2002). However, it is rather surprising that there is a lack of studies on how experiences should be aligned to adult learning goals and to what extent they can be used to improve learning outcomes. Moreover, there is no evidence that exploring past peers' experiences is beneficial to an effective learning process and learning outcome. Future research should focus on expanding and examining the effects of P2P engagements in adult learning using a theory (e.g. andragogy), with different sets of methods and tools being prescribed for online collaborative learning environments, informal learning, and peer to peer interactions.

With these in mind this paper suggests that future research provide empirical evidence of the effectiveness of P2P engagement in online collaborative learning environments. The findings call for more studies for further exploration of the connection between the characteristics of adult learning and the level of P2P engagement in

online collaborative learning environments as well as their impact on adult learning outcomes. In addition, future research is needed to study factors relevant to adult learners' adaptability to online learning environments and practice. Lastly, it is important to undertake participatory studies that capture the perception of adult learners for a better understanding of factors that may hinder adult learners' experience.

Conclusion

This paper has reviewed 31 studies related to the adult learning in online collaborative learning environments, and explored adult learning characteristics using the andragogy theory. The findings show that different terms have been used to refer to adult learning characteristics; they were often used interchangeably. One important finding of this study was discovering characteristics of P2P adult learning based on current theories and terminologies used in past papers. Adult learners are independent, self-concept, experienced, and problem centered learners whose main goal is to achieve a relevant professional outcome. Categorizing adult learning's characteristics from literature allows researchers to identify the areas of adult learning process and activities, as well as gaps and opportunities for further research. Based on the findings, directions and suggestions for future adult learning research have been identified.

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